PHM 387M  
Fall 2018  
Physical and Chemical Principles of Drugs  
Course Syllabus

Instructors:  
Dr. Maria Croyle  
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and by appointment  
Telephone: 471-1972  
e-mail: macroyle@austin.utexas.edu  

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e-mail: dghosh@austin.utexas.edu  

Teaching Assistants  
Academic Assistant

Class Time and Location  
M 9-11 AM  PHR 2.110  
unique number: 59680  
F 9-10 AM  PHR 2.110

Textbooks for the Course  
There are no required textbooks for this course. However, if a student would like additional information relative to the subjects covered in lecture, they are referred to the following texts:


Note: Most of the textbooks listed here are in either the Life Science or Chemistry libraries on campus. Any general chemistry book or physical chemistry book will provide suitable information on subjects covered in this course.
**Course Objectives:**

Many significant advances made in the pharmaceutical sciences in recent years are in large part attributable to the accelerated development of knowledge of the molecular structure and physicochemical properties of drugs.

This course is designed to review certain concepts presented in various general and physical chemistry courses taken in the pre-pharmacy curriculum and address how these influence the safety, effectiveness and reliability of medicinal products. After completing this course students should be able to:

* **understand the rationale and theory** used to describe and monitor biological (drug absorption) and physical (drug solubility, drug degradation) processes routinely encountered in pharmaceutical practice.

* **critically evaluate given data sets** to identify parameters that dictate how safe, effective and reliable a given medicinal preparation will be and how these could be altered to improve drug efficacy in given situations.

* **accurately and adeptly perform calculations** based upon general chemical principles to predict how medicinal preparations will perform in the body as well as in a given dosage form on the pharmacy shelf.

* **appreciate** that this knowledge will not only form a basis for understanding concepts introduced later in the curriculum but is critical for the evaluation and preparation of any dosage form prior to dispensing them to a patient.

* **effectively interface with practitioners and basic scientists** involved in formulation development and preparation of both novel and traditional medicinal preparations.
Required Materials
The content of this course will require students to assess data and perform calculations. Thus, all students must have a Texas Instruments TI-36X-Pro calculator. There are no exceptions to this requirement. This calculator must be brought to all pre-laboratory lecture sessions in order to complete the quiz problems and to the laboratory in order to complete the assigned activities. Calculators will not be provided. Students that arrive with any other type of calculator will be turned away from all exams and quizzes.

Computer Use
All students are required to have access to computers. Exams will be administered using the ExamSoft program and will require use of a laptop computer for all midterm examinations. A computer will also be useful for completing some of the laboratory assignments (PHM 187P).

Course Prerequisites
Prior to enrolling in the course, students are to be in the first professional year of the pharmacy curriculum and have successfully completed the prerequisite mathematics and chemistry courses including algebra, calculus, and general chemistry and will be held responsible for understanding the concepts presented in these previous courses. In addition, students must also be concurrently enrolled in PHM 187P Physical and Chemical Principles of Drugs Laboratory.

The Canvas Learning Management System
Lecture notes and “Take Home Messages” will be posted online on Canvas unless otherwise stated. You can access Canvas by going to the following link http://canvas.utexas.edu/. You will see a burnt orange button at the top left hand side of the screen with a picture of the tower on it labeled “Canvas Login”. This will bring you to a prompt that will ask you for your UTEID and password. Once you have logged in, you can find the page for PHM 387M under the “Courses” tab. This will be the place to go for obtaining lecture handouts, viewing new announcements and postings, turning in assignments and viewing your exam grades. Any questions about using Canvas can be discussed with Dr. Croyle, Dr. Ghosh or any of the teaching assistants.

ExamSoft®/Examplify Software®
Students are responsible for the maintenance of their approved personal devices and Examplify® software. Students are required to bring approved personal devices for all exams and indicated assignments. Lack of preparation may result in an inability to take the exam or adjustments to course grades at the discretion of course coordinators and/or unprofessional conduct referral.

Any problems with Examplify® or ExamSoft® should be addressed via phone to Student Tech Support at 866-429-8889, email to: support@examsoft.com, or live chat at www.examsoft.com. Do not expect your Dr. Ghosh, Dr. Croyle or your teaching assistants to troubleshoot your technology issues.
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Class Format
Monday session: Start at 9 AM sharp!
Generally, the first 10 minutes will consist of a review of material from the previous lecture. This is the best time for questions. Thus, it is to your best advantage to arrive on time for class as it is very likely that information discussed during this time will show up on midterm exams.

9:50 - 10 minute break
10:00 AM - Continuation of lecture
10:50 AM - Adjournment

The Friday lecture will be run in a similar manner without the break at the end of the first hour.

To get the most out of this course
a. Class attendance is expected.
b. Be on time. If you arrive early, sit up front.
c. Be quiet when entering the lecture room if class has already started. Your colleagues will thank you later for not distracting them from hearing what is going on.
d. Review your notes (or Take Home Messages at the minimum) prior to class and come prepared with questions if something is not clear.
e. If you find that you do not understand specific concepts after attending class and reviewing your notes, make time to visit Dr. Croyle, Dr. Ghosh or your Teaching/Academic Assistants during their office hours! Students that have not done well in the course have not followed this last suggestion and, as a result, did not address deficiencies in understanding concepts until it was too late.

Course Grading
Four examinations will be given: three mid-term exams and one final exam. Each of the exams will be of equal value and will count as 25% of the course grade. The final exam will also count as 25% of the course grade.

Grades will be based on the calculated semester average according to the following formula:

Semester average = (Exam I)(0.25) + (Exam II)(0.25) + (Exam III)(0.25) + (Final Exam)(0.25)

Grade assignments will be as follows:
A = 93-100%  A- = 90-92%
B+ = 87-89%  B = 83-86%  B- = 80-82%
C+ = 77-79%  C = 73-76%  C- = 70-72%
D+ = 69-67%  D = 66-60%
F < 60%
Examination Dates
The exams for PHM 387M will be given on the following dates at the following times:

<table>
<thead>
<tr>
<th>Date</th>
<th>Exam</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>October 4, 2018</td>
<td>Exam I</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.108 (Monday lab)</td>
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<td></td>
<td></td>
<td></td>
<td>PHR 2.110 (Tuesday lab)</td>
</tr>
<tr>
<td>November 1, 2018</td>
<td>Exam II</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.108 (Monday lab)</td>
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<td></td>
<td></td>
<td></td>
<td>PHR 2.110 (Tuesday lab)</td>
</tr>
<tr>
<td>November 29, 2018</td>
<td>Exam III</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.108 (Monday lab)</td>
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<td>PHR 2.110 (Tuesday lab)</td>
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</tbody>
</table>

TBD  Final Exam  TBD

Examination Policies
During exams, students are required to place their bags and other belongings in the front or side of the classroom. Therefore, this environment MAY NOT be conducive to carrying a concealed weapon (https://campuscarry.utexas.edu/). Please be advised that it is the licensed carrier’s responsibility to be compliant with the University’s policies.

Exams will begin promptly at their scheduled times. Students who complete the exam early will be required to remain in the exam room during, at least, the first half of the exam period. After the first half of the exam period is over, students who have completed the exam may leave the room after submitting their exam through the Examplify® site and showing Drs. Croyle, Ghosh or a TA they have successfully submitted their work. Students who arrive at the room after the exam has been started will not be given additional time to complete the exam. Students who arrive at the examination room after the first half hour of the scheduled exam period is over will not be allowed to take the exam and will receive a score of ‘0’ for that exam.

No allowances will be made for an exam being missed, other than by written statement from a physician in the case of personal illness. If an exam is to be missed, the instructor must be notified prior to the time when the exam is scheduled. If permission is granted by telephone at the last minute (e.g. due to sudden illness) the student must confirm the request in writing as soon as possible (see College Policy on Rescheduling an Exam below) and provide the instructor with a written medical excuse for the absence. In this event, the student will be required to take a make up exam as quickly as possible. This exam may be of the format selected by the instructor, which may not be the same format given during the examination time (i.e. oral, essay, etc.). Any unexcused absence will result in a score of ‘zero’ for that exam.

Midterm exams will be graded and promptly returned to students. The final exam will not be returned. Students will need to present their identification cards in order to review the graded final exam. No exceptions will be made.
Posting Student Scores
Students can access their exam scores via the Canvas page for this course. This can be accessed by logging on to UT Direct using your UTEID (see section on Canvas above). Students will also receive additional feedback about exam performance though a “Student Report Card” as part of the Examplify® software package.

Academic Dishonesty
The “Statement on Scholastic Dishonesty of the College of Pharmacy” reads as such: ”Pharmacy practitioners enjoy a special trust and authority based upon the profession’s commitment to a code of ethical behavior in its management of patient affairs. The inculcation of a sense of responsible professional behavior is a critical component of professional education, and high standards of ethical conduct are expected of pharmacy students. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including failure of the course involved and dismissal from the College and/or the University. Since dishonesty harms the individual, fellow students, and the integrity of the University and the College of Pharmacy, policies of scholastic dishonesty will be strictly enforced in this class.”

Students are expected to work independently on all examinations and on all laboratory quizzes and problem sets (unless specifically instructed otherwise). Any student caught cheating will be given a “zero” on the assignment at a minimum. Any student suspected of dishonesty will be reported to the Dean of the College of Pharmacy and to the Dean of Students, as per University regulations. Students are expected to have read and understood the current issue of the General Information Catalog published by the Registrar’s Office for information about procedures and what constitutes academic dishonesty. Students are also expected to be familiar and abide by the College Honors Code, and will be expected to sign the Honors Statement at the end of each examination.

The Honors Statement will be summarized by the following statement on the login page for each exam through the Examplify® software:

“I have neither participated in nor witnessed any acts of academic dishonesty pertaining to this exam.”

Entering your assigned password and clicking the “Accept” button will serve as your agreement to this statement. If a student observes what might be dishonest conduct during an exam, they are encouraged to notify Dr. Croyle or Dr. Ghosh to discuss this issue.

Students found improperly using ExamSoft® or Examplify® to gain unfair academic advantage are violating the College of Pharmacy Honor Code. Violations such as "academic dishonesty" and/or “professional misconduct" would include, but are not limited to, using a classmate's login/password, tampering with exam files, and falsifying upload or download information, or any attempt to circumvent the security features of the software.
Post-Exam Remarks and Reconsideration Requests
If a student believes that an error has been made in grading an exam question, the student must provide a written justification explaining a) why the answer they chose was correct and b) why the answer indicated on the key is incorrect to the instructor responsible for administration of the exam within one week of the exam return date. This will allow the error to be corrected in a timely manner. After the one week period for corrections, NO ADDITIONAL CHANGES will be made to exam grades.

Final Exam Re-Examination Policy
Re-examination on the final exam (as described in the University’s policy on “Re-Examination Petition”) will not be an option in this course.

Campus Carry Students should familiarize themselves with the information provided by the University regarding the implementation of “Campus Carry” legislation. You will find an information sheet specifically for students (as well as sheets for parents, visitors, faculty, and staff) at http://campuscarry.utexas.edu/info-sheets.

Students with Disabilities
The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. All University rules concerning accommodations must be followed, including the student arranging for special accommodations prior to each examination. Please contact Services for Students with Disabilities at 512-471-6259 (phone), 512-410-6445 (video phone) or ssd@austin.utexas.edu (email) as soon as possible to request an official letter outlining authorized accommodations. Then submit your accommodation paperwork to Dr. Croyle and Dr. Ghosh immediately thereafter. In the absence of such pre-arrangement, the student will be expected to take the exam with the rest of the class at the regularly scheduled exam time.

Electronic Devices
To be courteous of others, please turn off or silence your cell phones prior to attending class. Except for calculators and laptops, use of electronic devices is prohibited during exams and quizzes.

Accommodation for Religious Holidays
By University policy, you must notify the instructor of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class or an examination in order to observe a religious holy day, you will be given the opportunity to complete the missed work within a reasonable time after the absence.

### Lecture Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture #</th>
<th>Topic</th>
<th>(Ghosh)</th>
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</thead>
<tbody>
<tr>
<td>8/31</td>
<td></td>
<td>Introduction to Physical Pharmacy</td>
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<tr>
<td>9/3</td>
<td></td>
<td>No lecture – Happy Labor Day!</td>
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<tr>
<td>9/7</td>
<td>1</td>
<td>Introduction to Thermodynamics</td>
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<tr>
<td>9/10</td>
<td>2</td>
<td>Thermodynamics: The First and Second Laws</td>
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<tr>
<td>9/14</td>
<td>3</td>
<td>Gibbs Free Energy and Spontaneous Processes</td>
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<tr>
<td>9/17</td>
<td>4</td>
<td>Chemical Equilibrium: Le Chatelier’s Principle, the Reaction Quotient and the van’t Hoff Equation</td>
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<tr>
<td>9/21</td>
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<td>No lecture – Dr. Ghosh at NanoDDS Meeting!</td>
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<tr>
<td>9/24</td>
<td>5</td>
<td>Intermolecular Interactions</td>
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<tr>
<td>9/28</td>
<td>6</td>
<td>Colligative Properties of Solutions: Raoult’s Law</td>
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<tr>
<td>10/1</td>
<td>7</td>
<td>Colligative Properties of Solutions: Vapor Pressure Lowering and Boiling Point Elevation</td>
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<tr>
<td>10/4</td>
<td>Exam I</td>
<td>7:00-9:00 PM</td>
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<td></td>
<td>PHR 2.108 (Monday lab)</td>
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<td>PHR 2.110 (Tuesday lab)</td>
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<tr>
<td>10/5</td>
<td>8</td>
<td>Colligative Properties: Freezing Point Depression and Osmotic Pressure</td>
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<tr>
<td>10/8</td>
<td>9</td>
<td>Role of Tonicity in the Preparation of Pharmaceutical Solutions</td>
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<tr>
<td>10/12</td>
<td>10</td>
<td>Chemical Kinetics- Rate Laws and Order of Reaction</td>
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<tr>
<td>10/15</td>
<td>11</td>
<td>Temperature, pH and Drug Degradation Processes</td>
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<tr>
<td>10/19</td>
<td>12</td>
<td>Methods of Data Collection and Analysis to Assess Drug Stability</td>
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</tbody>
</table>
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### Lecture Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture #</th>
<th>Topic</th>
<th>Course</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/22</td>
<td></td>
<td>No lecture!</td>
<td></td>
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<tr>
<td>10/26</td>
<td>13</td>
<td>Chemical Equilibrium and Drug Complexation (Croyle)</td>
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<tr>
<td>10/29</td>
<td>14</td>
<td>Chemical Equilibrium and Partition Coefficients: Role in Drug Solubility and Drug Action (Croyle)</td>
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<tr>
<td>11/1</td>
<td>Exam II</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.108 (Monday lab)</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.110 (Tuesday lab)</td>
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<tr>
<td>11/2</td>
<td>15</td>
<td>Drug Complexation and Introduction to Pharmaceutical Solubility (Croyle)</td>
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<tr>
<td>11/5</td>
<td>16</td>
<td>The Common Ion Effect (Croyle)</td>
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<tr>
<td>11/9</td>
<td>17</td>
<td>The Common Ion Effect and Other Principles of Drug Solubility (Croyle)</td>
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<tr>
<td>11/12</td>
<td>18</td>
<td>Introduction to Acid Base Equilibria (Croyle)</td>
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<tr>
<td>11/16</td>
<td>19</td>
<td>Acid Base Equilibria and Solubility (Croyle)</td>
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<tr>
<td>11/19</td>
<td>20</td>
<td>Acid Base Equilibria and Biological Buffers (Croyle)</td>
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<tr>
<td>11/23</td>
<td></td>
<td>No lecture – Happy Thanksgiving! (Croyle)</td>
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<tr>
<td>11/26</td>
<td>21</td>
<td>Buffer Design and the Henderson Hasselbalch Equation (Croyle)</td>
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<tr>
<td>11/29</td>
<td>Exam III</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.108 (Monday lab)</td>
<td>7:00-9:00 PM</td>
<td>PHR 2.110 (Tuesday lab)</td>
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<tr>
<td>11/30</td>
<td>22</td>
<td>pH and Drug Solubility (Croyle)</td>
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<tr>
<td>12/3</td>
<td>20</td>
<td>pH and Drug Absorption (Croyle)</td>
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<tr>
<td>12/7</td>
<td>22</td>
<td>Rheology (Croyle)</td>
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<tr>
<td>12/10</td>
<td>23</td>
<td>Physical Chemical Properties of Biotechnology Derived Medications (Peptides, Proteins, Antibodies, Vaccines) (Croyle)</td>
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</tbody>
</table>
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Course Outline

1. Introduction
   1.1 What is Physical Pharmacy?
   1.2 Role of Physical Pharmacy in Daily Pharmaceutical Practice
      a) Examples of Drug Stability
      b) Examples of Drug Reliability
      c) Examples of Drug Safety

2. Thermodynamics
   2.1 Basic definitions
   2.2 State Functions
   2.3 Equilibrium and relation to State Functions
   2.4 Effect of temperature on equilibrium
      a) the van’t Hoff equation

3. Intermolecular Interactions
   3.1 Modes of Interaction
   3.2 Intermolecular Interactions and drug formulation and drug action
   3.3 Interactions in pure compounds
      a) boiling point
      b) melting point
   3.4 Relationship between melting and boiling point
      a) methods for prediction of melting and boiling point
   3.5 Interactions in Solution
      a) solubility
      b) partition coefficient
      c) Raoult’s Law
      d) colligative properties
      e) adjusting tonicity

4. Equilibria Important to the Pharmaceutical Sciences
   4.1 Chemical Reactions
   4.2 Complexation
      a) drug, receptor
      b) drug, protein
      c) drug, drug
      d) complexation and drug stability
   4.3 Vapor Pressure
      a) aerosols and Raoult’s Law
   4.4 Solubility
      a) electrolytes
      b) non-electrolytes
   4.5 Partitioning of Non-Electrolytes
5. Acid/Base Equilibria
   5.1 Basic definitions
   5.2 Solving pH and buffer problems
       a) pH and buffer problems in physiology
   5.3 Effect of pH on solubility of drugs
   5.4 Effect of pH on drug partitioning and absorption

6. Chemical Kinetics
   6.1 Basic concepts
   6.2 Zero order processes
   6.3 First order processes
   6.4 Pseudo-order processes
   6.5 Effect of temperature on rate of a process
   6.6 Effect of pH on rate of a process